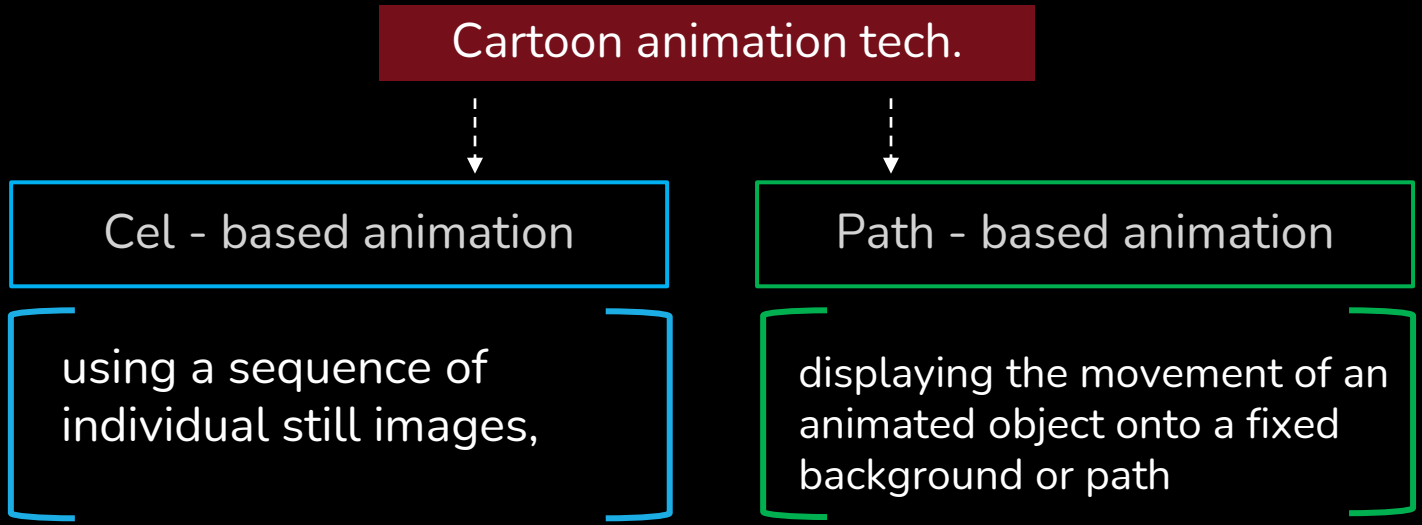
Animation in Computer Graphics

Presenter: Le Ngoc Hanh

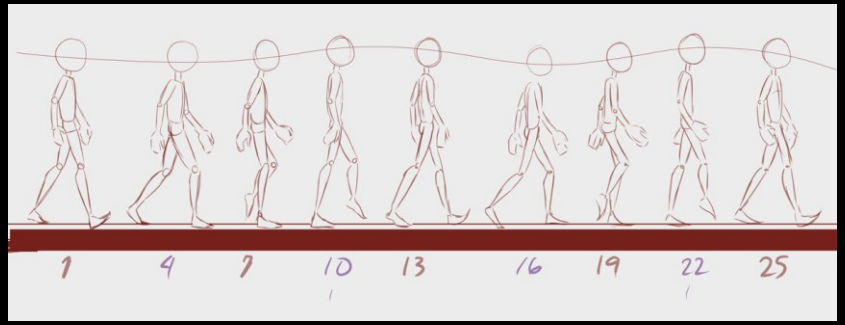
Outline

- Cartoon animation techniques
  - Golden age
  - Digital age
- Research side
- Text – driven animation

Cartoon animation techniques



Cartoon animation techniques



Cel ani. benefits

=

Time

+

Consistency

+

Archive

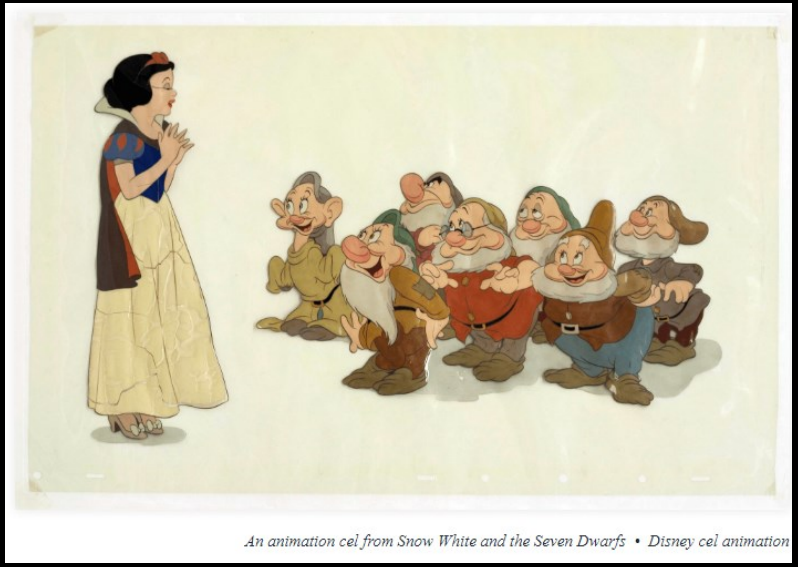
+

Reuse

Path animation

Cel animation

Cel animation

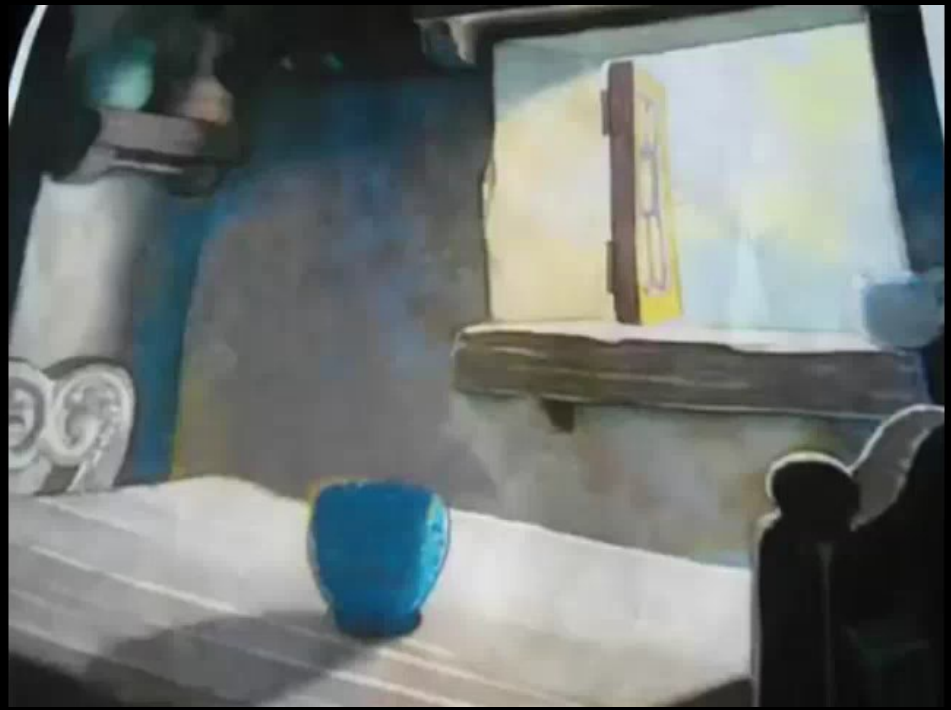


An animation cel from Snow White and the Seven Dwarfs • Disney cel animation

Cel animation

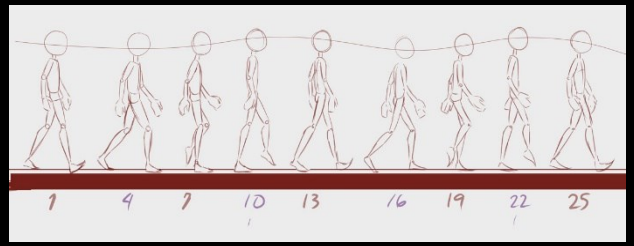
Cel animation

Cel / frame preparation



Create animation

Cartoon animation techniques



Pros. =
- Time
- \+ Consistency
- \+ Archive
- \+ Reuse

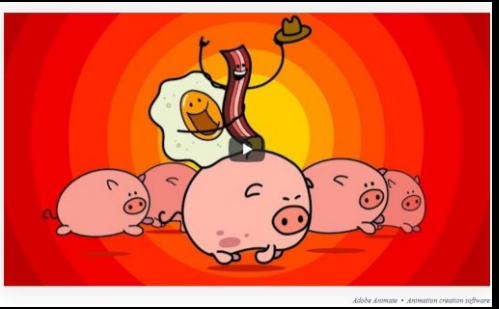
Cons. =
- Time-consuming
- \+ Expensive

Cel animation in the digital age

Adobe Animate

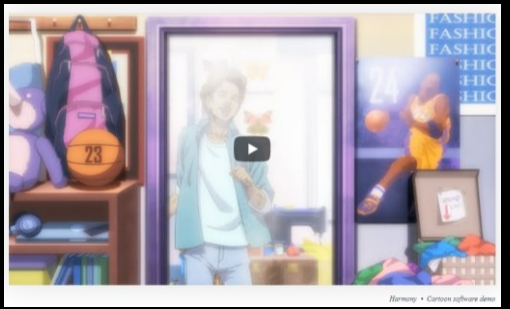
Get to Know Animate CC • Best animating softwares

Adobe Character Animator



Adobe Animate • Animation creation software

Toon Boom Harmony

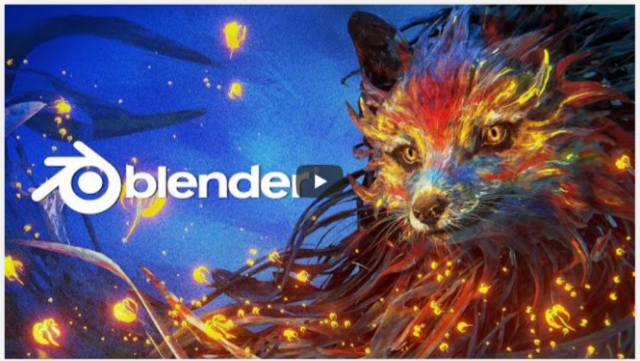


Harmony • Cartoon software demo

Autodesk Maya

Modeling in Maya • Animation programs workflow

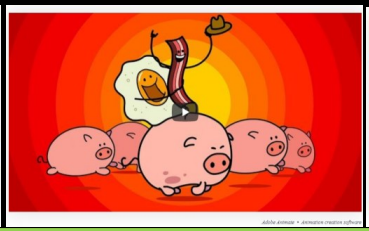
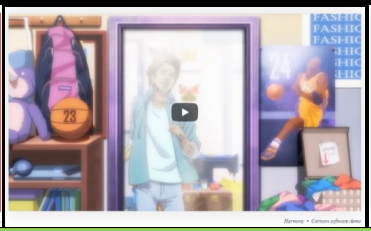
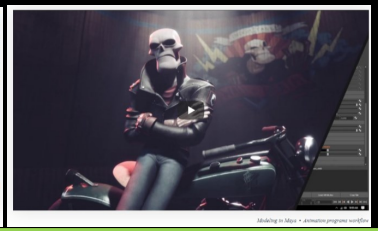
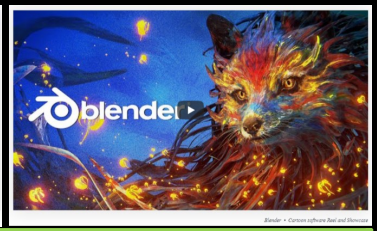
Blender



Blender • Cartoon software Reel and Showcase

Cel animation in the digital age

Cel animation in the digital age

Basic animation

Research side of animation producing

IEEE TRANSACTIONS ON VISUALIZATION AND COMPUTER GRAPHICS

2023

Regenerating Arbitrary Video Sequences with Distillation Path-Finding

Thi-Ngoc-Hanh Le, Shang-Yi Yao, Chun-Te Wu, and Tong-Yee Lee, *Senior Member, IEEE*

Eurographics/ACM SIGGRAPH Symposium on Computer Animation (2004)
R. Boulic, D. K. Pai (Editors)

Cartoon Textures

Christina de Juan[†] and Bobby Bodenheimer[‡]

Vanderbilt University

IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 20, NO. 12, DECEMBER 2010

Recognizing Cartoon Image Gestures for Retri and Interactive Cartoon Clip Synthesis

Yi Yang, Yueting Zhuang, *Member, IEEE,* Dacheng Tao, *Member, IEEE,* Dong Xu, *Member, IEEE,* Ju and Jiebo Luo, *Fellow, IEEE*

IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART B: CYBERNETICS, VOL. 42, NO. 5, OCTOBER 2012 1413

On Combining Multiple Features for Cartoon Character Retrieval and Clip Synthesis

Jun Yu, Dongquan Liu, Dacheng Tao, *Senior Member, IEEE*, and Hock Soon Seah

Learning a perceptual manifold with deep features for animation video resequencing

Charles C. Morace[1] · Thi-Ngoc-Hanh Le[1] · Sheng-Yi Yao[1] · Shang-Wei Zhang[1] · Tong-Yee Lee[1]

Received: 25 January 2021 / Revised: 4 June 2021 / Accepted: 14 January 2022 /
Published online: 18 March 2022

Research side of animation producing

Eurographics/ACM SIGGRAPH Symposium on Computer Animation (2004)
R. Boulic, D. K. Pai (Editors)

Cartoon Textures

Christina de Juan[†] and Bobby Bodenheimer[‡]

Vanderbilt University

Research side of animation producing

Cartoon texture [a]

- Pre-processing is needed.
- Simple cartoon characters
- Simple motion

[a] de Juan, Christina, and Bobby Bodenheimer. "Cartoon textures." *Proceedings of the 2004 ACM SIGGRAPH/Eurographics symposium on Computer animation*. 2004.

Research side of animation producing

IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, VOL. 20, NO. 12, DECEMBER 2010

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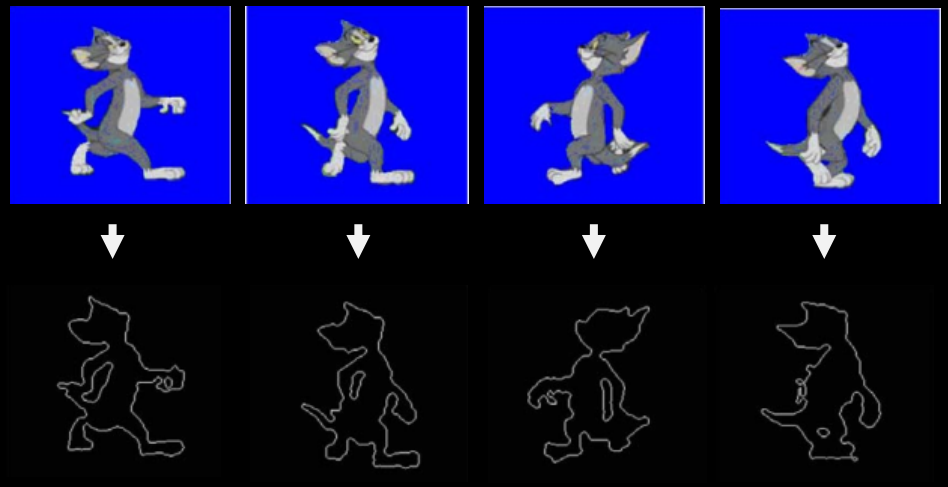
Research side of animation producing



CGS [b]

- Need a pre-processing
- Motion analysis based on Gesture/ Shape of characters
- Simple motion
- Focus on cartoon characters

[b] Yang, Yi, et al. "Recognizing cartoon image gestures for retrieval and interactive cartoon clip synthesis." *IEEE transactions on circuits and systems for video technology* 20.12 (2010): 1745-1756.

IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS—PART B: CYBERNETICS, VOL. 42, NO. 5, OCTOBER 2012

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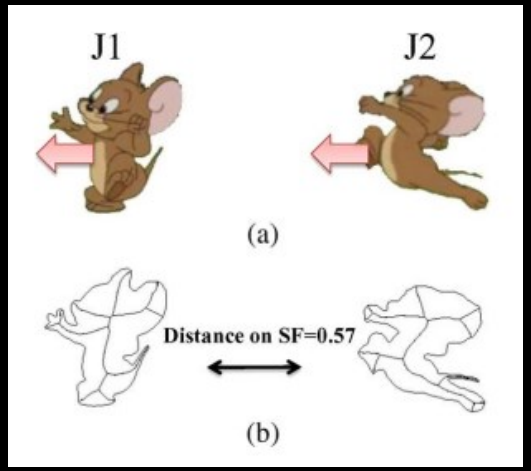
Research side of animation producing

Semi-MSL [c]



Simple motion

Some simple cartoon data

[c] Yu, Jun, et al. "On combining multiple features for cartoon character retrieval and clip synthesis." *IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics)* 42.5 (2012): 1413-1427.

Research side of animation producing

Learning a perceptual manifold with deep features for animation video resequencing

Charles C. Morace[1] · Thi-Ngoc-Hanh Le[1] · Sheng-Yi Yao[1] · Shang-Wei Zhang[1] · Tong-Yee Lee[1]

Received: 25 January 2021 / Revised: 4 June 2021 / Accepted: 14 January 2022 /
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Research side of animation producing

Manifold sequence [d]

Heavily relying on the performance of an off-the-shelf distance metric LPIPS

Motion direction is not considered

Real-world videos with dense of motion → Fail

Resequence the source video, not from arbitrary frame.

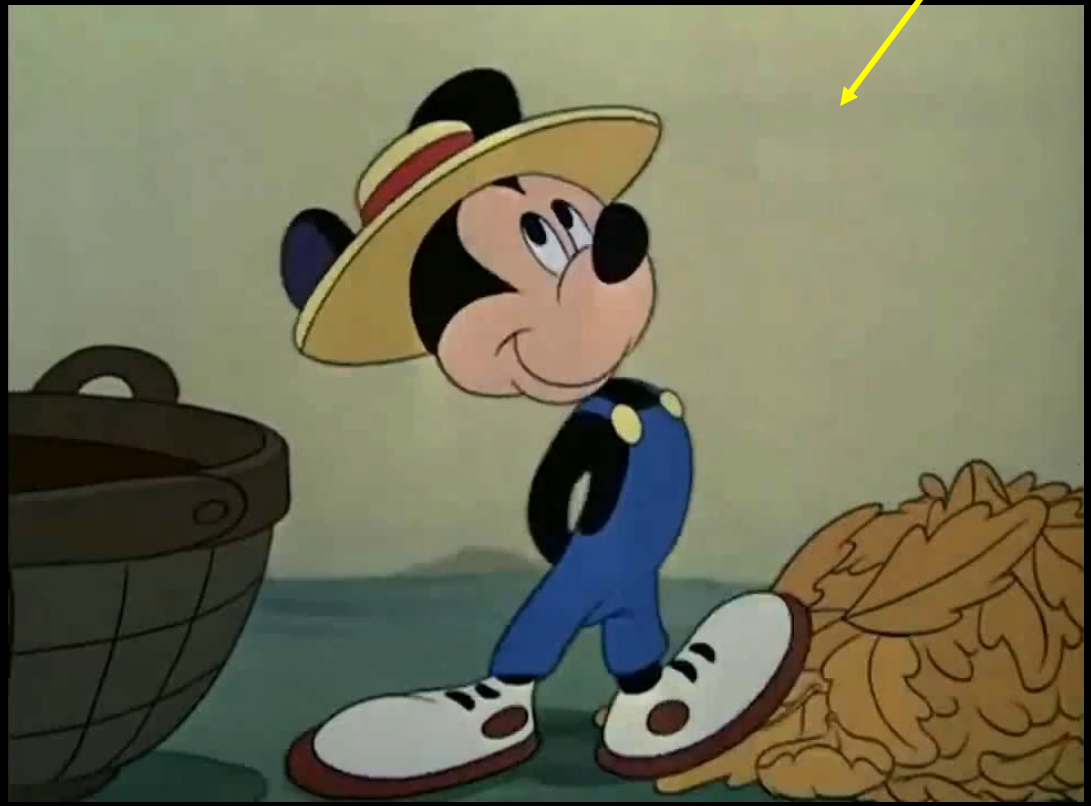
[d] Morace, Charles C., et al. "Learning a perceptual manifold with deep features for animation video resequencing." *Multimedia Tools and Applications* (2022): 1-21.

Research side of animation producing

Methods	Pre-processing	New sequence?	Type of data
GCCS [3]	Yes	No	Cartoon characters
RCCS [26]	Yes	No	Cartoon characters
semi-MSL [28]	Yes	No	Cartoon characters
Manifold [17]	No	No	Cartoon scenes

Deficiencies

- Linear motion segments
- Cartoon and natural scene
- Diversity in content and background.
- New sequences from arbitrary starting frame



Research side of animation producing

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Deficiencies

- Linear motion segments
- Cartoon and natural scene
- Diversity in content and background.
- New sequences from arbitrary starting frame

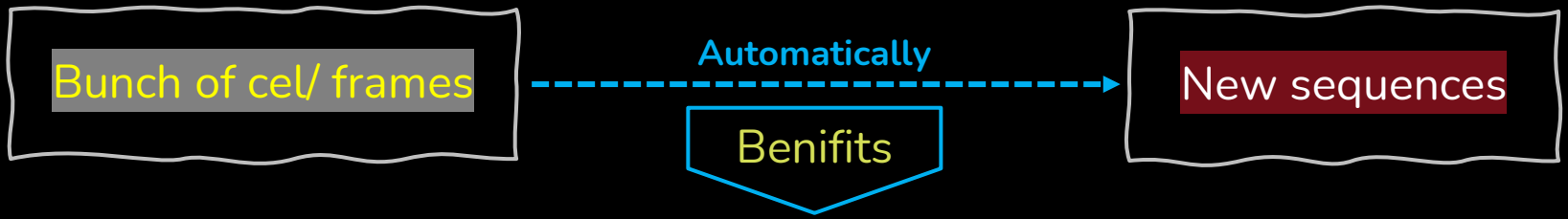
Dense of moving objects in real-world videos

Input video Output sequence

Motions of both foreground and background

Input video Output sequence

Research side of animation producing



- Speed up the time of producing an art
- Easily create variations of the existing material
- Expertise-free

Research side of animation producing

IEEE TRANSACTIONS ON VISUALIZATION AND COMPUTER GRAPHICS

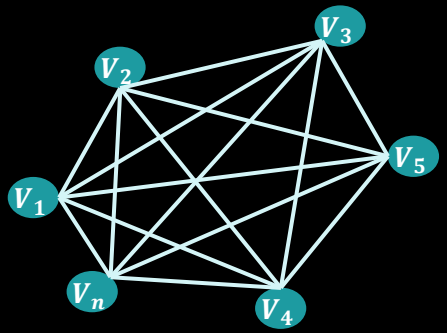
Regenerating Arbitrary Video Sequences with Distillation Path-Finding

Thi-Ngoc-Hanh Le, Shang-Yi Yao, Chun-Te Wu, and Tong-Yee Lee, *Senior Member, IEEE*

Regenerating arbitrary video sequences with Distillation Path-Finding

Input sequence

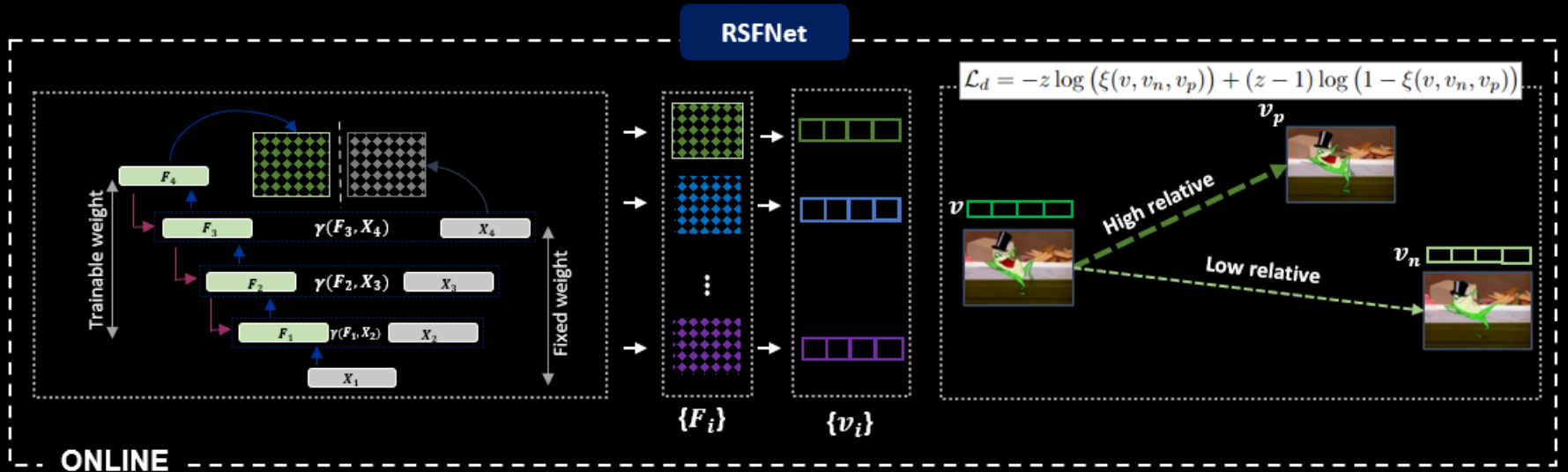
ONLINE



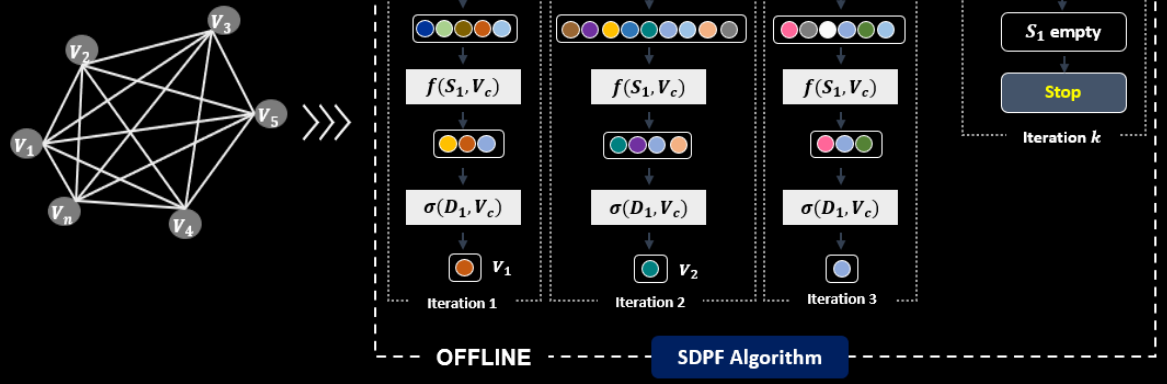
OFFLINE

Output sequence

Regenerating arbitrary video sequences with Distillation Path-Finding



Regenerating arbitrary video sequences with Distillation Path-Finding



Algorithm 1 SDPF Algorithm

Input: Set of latent vectors $\{v_i\}$, distance metric $\{d_{ij}\}$

$\mathcal{V} \leftarrow \{v_i\}, \mathcal{E} \leftarrow \{d_{ij}\}$;
Construct graph $\mathbf{G} = (\mathcal{V}, \mathcal{E})$;
$V_o \leftarrow$ user's selection;
Initialize a list $\mathcal{P}$ to subsequently push the selected node to the path;
Add V_o to $\mathcal{P}$
$V_c \leftarrow V_o$; /* V_c is the node at current state*/
/* Distillation in the first layer*/
for each node $V_j \in \mathbf{G}(\mathcal{V} - \mathcal{P})$ **do**
  if $e_{cj} < \eta$ **then** /* η is defined in Eq.(8)*/
    Add V_j to $\mathcal{S}_1$
  end if
end for
/* Distillation in the second layer */
for each node $V_k \in \mathcal{S}_1$ **do**
  if $V_c \in LMS$ **then**
    $\mathcal{S}_2 = C_d(V_c, V_k) + C_t(V_c, V_k)$
  else
    $\mathcal{S}_2 = C_t(V_c, V_k)$
  end if
end for
for each $V_i \in \mathcal{S}_2$ **do**
  Compute possibility Ω for each V_i by Eq.(20);
end for
Choose V_i by randomly selecting Ω;
Add V_i to path $\mathcal{P}$;
Update $V_c \leftarrow V_i$

Output: Sequence of path $\mathcal{P}$

Regenerating arbitrary video sequences with Distillation Path-Finding

Directional constraint

Coherent constraint

$$\mathcal{S}_2 = \begin{cases} \mathbf{C}_d(V_c, V_k) + \mathbf{C}_t(V_c, V_k), & \text{if } V_c \in LMS \\ \mathbf{C}_t(V_c, V_k), \text{otherwise} \end{cases}$$

Directional distillation constraint $\mathbf{C}_d$

Case 1: Motions in source video are entirely linear






Original video

Rendered clip without constraint $\mathbf{C}_d$

Rendered clip with full configuration

Directional distillation constraint $\mathbf{C}_d$

Case 2: Source video with many linear motion segments

Original video

Rendered clip without constraint $\mathbf{C}_d$

Rendered clip with full configuration

Coherent distillation constraint $\mathbf{C}_t$

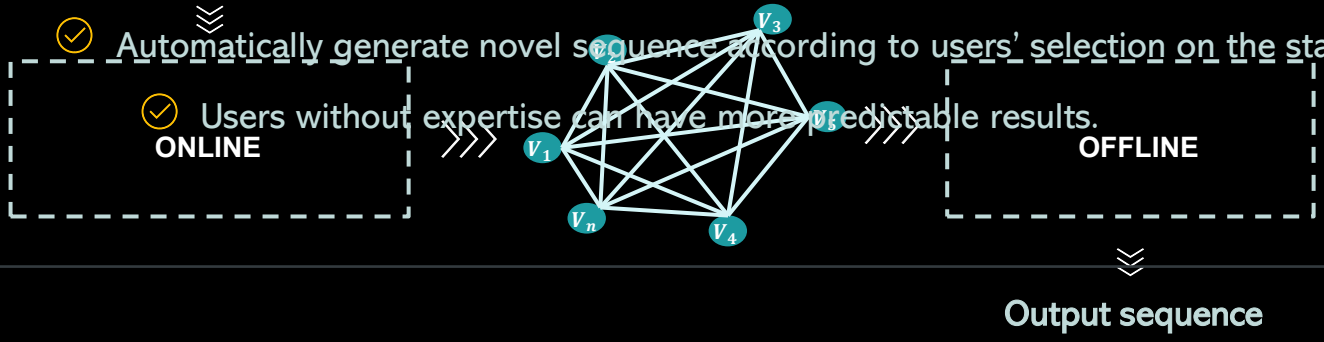
Original video

Rendered clip without constraint $\mathbf{C}_t$

Rendered clip with full configuration

SDPF - Benefits

- Handle both cartoon and natural scenes
- Work well with dense motions and multiple moving objects
- Automatically generate novel sequence according to users' selection on the starting frame
- Users without expertise can have more predictable results.



Advantage 1: Generating smooth sequence at arbitrary frame

Source video

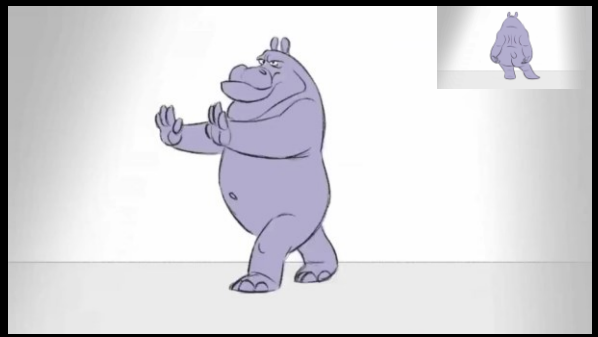
Source sequence starting at frame 426 (*)

Rendered clip with starting at frame 426

(*) On total 480 frames

Advantage 2: Start at the same frame but resulting different sequences

Top right is a sample segment that visualizes the difference in three videos



Original sequence at frame 0

Our system serves different sequences at frame 0

Advantage 3: Control consistency of motion of background and foreground

Bad result without our method

Original video

Backward motion

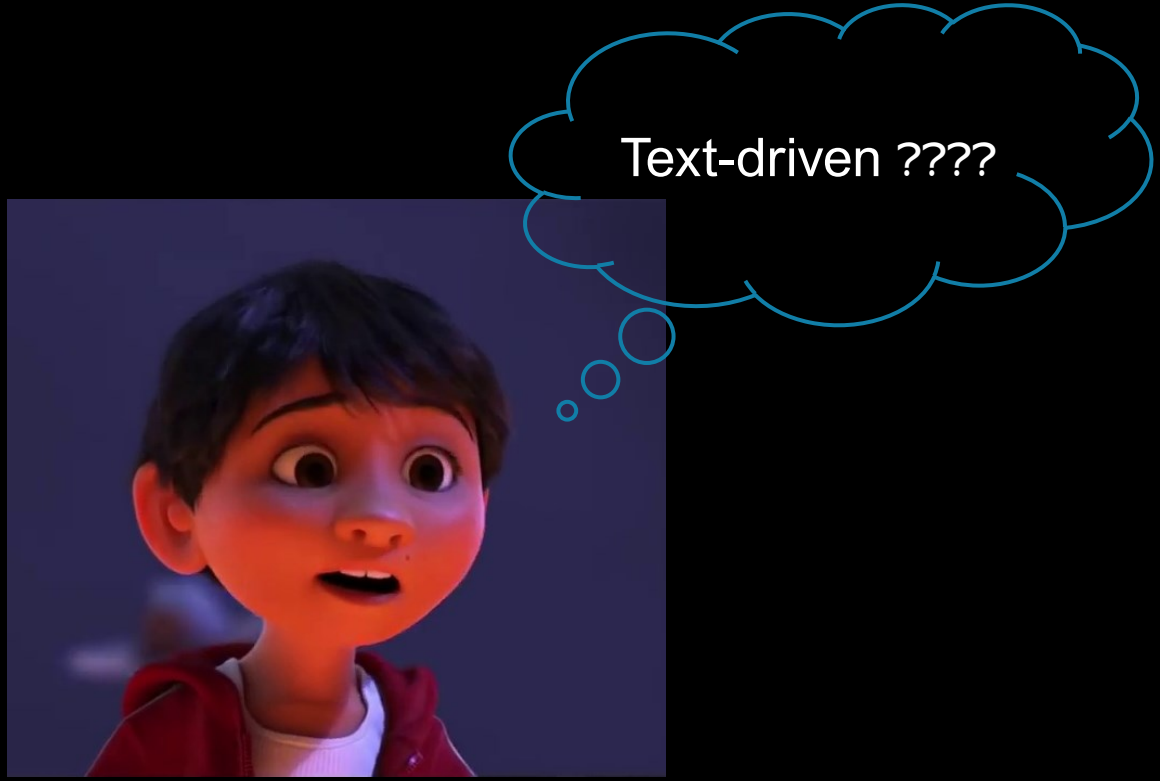
Forward motion

Advantage 4: Real-world videos with dense of moving objects

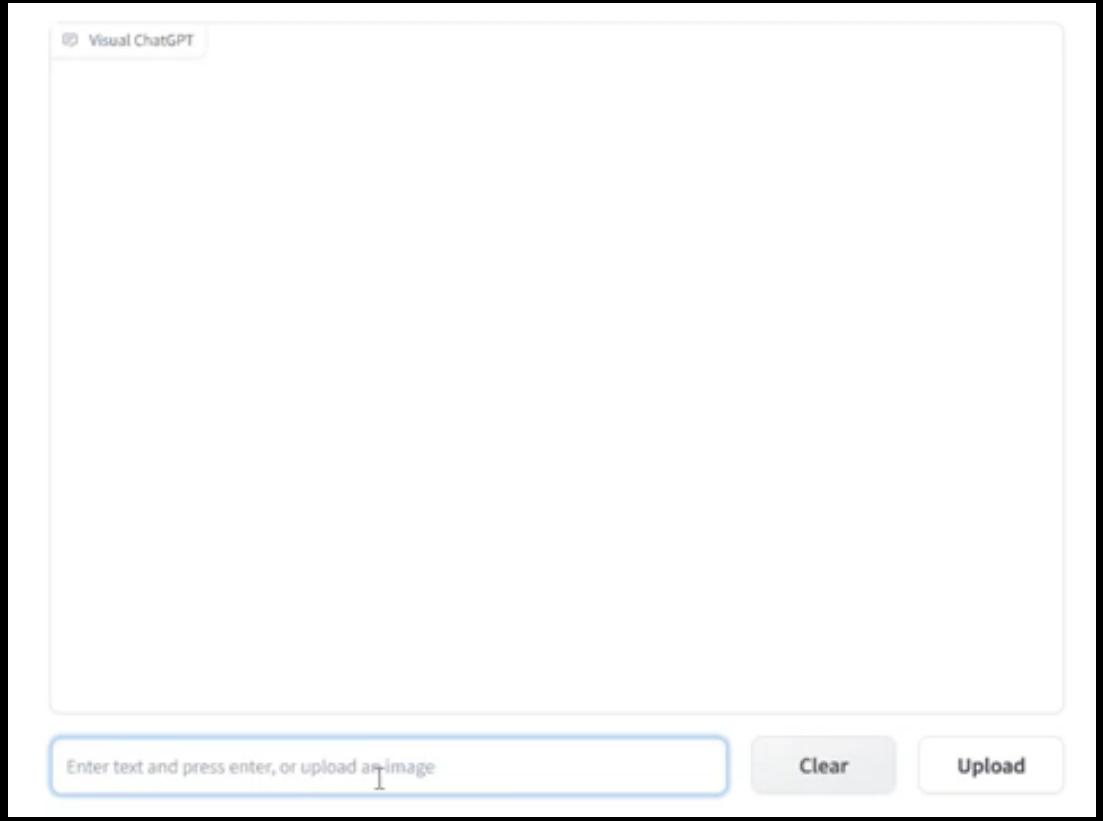
Original video; top-left is bad result without our method

Rendered result by our method

State-of-the-art generation of Animation



State-of-the-art generation of Animation



Visual ChatGPT

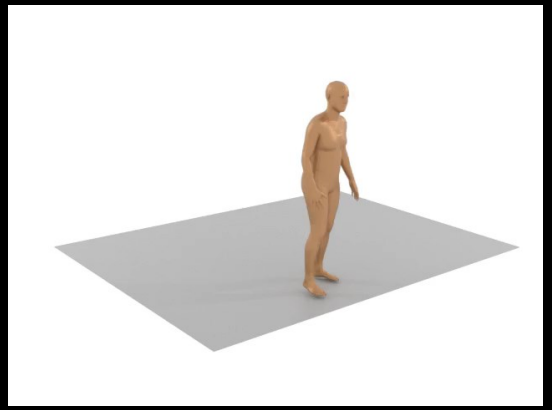
Text-driven animation

MDM: Human Motion Diffusion Model

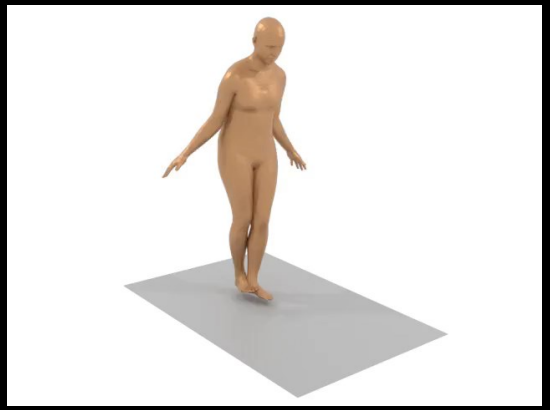
ICLR2023 (Top-25%)

Guy Tevet, Sigal Raab, Brian Gordon, Yonatan Shafir, Daniel Cohen-Or, Amit H. Bermano
Tel Aviv University, Israel

arXiv Code Demo



A person turns to his right and paces back and forth



A person is skipping rope

References

1. de Juan, Christina, and Bobby Bodenheimer. "Cartoon textures." In *Proceedings of the 2004 ACM SIGGRAPH/Eurographics symposium on Computer animation*, pp. 267-276. 2004.
2. Yang, Yi, Yueting Zhuang, Dacheng Tao, Dong Xu, Jun Yu, and Jiebo Luo. "Recognizing cartoon image gestures for retrieval and interactive cartoon clip synthesis." *IEEE Transactions on Circuits and Systems for Video Technology* 20, no. 12 (2010): 1745-1756.
3. Yu, Jun, Dongquan Liu, Dacheng Tao, and Hock Soon Seah. "On combining multiple features for cartoon character retrieval and clip synthesis." *IEEE Transactions on Systems, Man, and Cybernetics, Part B (Cybernetics)* 42, no. 5 (2012): 1413-1427.
4. Morace, Charles C., Thi-Ngoc-Hanh Le, Sheng-Yi Yao, Shang-Wei Zhang, and Tong-Yee Lee. "Learning a perceptual manifold with deep features for animation video resequencing." *Multimedia Tools and Applications* 81, no. 17 (2022).
5. Thi-Ngoc-Hanh Le, Sheng-Yi Yao, Chun-Te Wu, and Tong-Yee Lee. "Regenerating Arbitrary Video Sequences with Distillation Path-Finding." *IEEE Transactions on Visualization and Computer Graphics* (2023).
6. Tevet, Guy, Sigal Raab, Brian Gordon, Yonatan Shafir, Daniel Cohen-Or, and Amit H. Bermano. "Human motion diffusion model." *arXiv preprint arXiv:2209.14916* (2022).

End.

Thanks for your listening.